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A Web based System for Cricket Talent Identification, Enhancement and Selection (C-TIES)

[1]Gulfam Ahamad, [1]S. Kazim Naqvi, [2]M.M. Sufyan Beg, [1]Tanvir Ahmed

[1]FTK-Center for Information Technology, Jamia Millia Islamia, New Delhi- 110025, India
(gulfamahamad.jmi@gmail.com, sknaqvi@jmi.ac.in, tanvirahmed74@gmail.com)
[2]Department of Computer Engineering, AMU, Aligarh, U.P. 202002, India
(mmsbeg@eecs.berkeley.edu)

Abstract

Cricket is an extremely popular game. More than a million cricketers play cricket daily in India alone and aspire to become professional cricketers. Cricket Talent identification and enhancement is a challenging problem due to lack of quality coaches, meagre infrastructural facilities, and poor linkages of coaching academies & cricket authorities. In India, the problem is even tougher as the majority of the population resides in villages. Many of talented players do not get timely recognition of cricket boards' authorities thus amounting to waste of talent. Many keep on pursuing cricket despite of being non-talented. Due to lack of application of appropriate scientific methods the selection process is also criticized as biased by many. In this paper, we present a web based system viz. *Cricket Talent Identification, Enhancement and Selection (C-TIES)* for addressing the above issues. C-TIES utilize a cricket talent knowledgebase of experts' opinions aggregated by applying OWA Aggregation Operator and Relative Fuzzy Linguistic Quantifier (RFLQ). The C-TIES system classifies the cricket talent level of an enthusiast into five different classes by applying Normalized Adequacy Coefficient (NAC). The Talent Enhancement and Talent Selection subsystems also uses appropriate algorithms based on OWA, RFLQ and NAC to respectively enable identification of weaknesses in a player and select most talented n-players from a larger group of players. Thus, system reduces the time for identifying weaknesses and also provides a relatively better unbiased selection method for short listing players. The system has been developed using Struts 2.0, Hibernate, J2EE, Ajax, MySql are used.

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1. Introduction

Talent is defined as a natural endowment of a superior quality of a person, which can be enhanced[4-6]. Talent plays a significant role in everyone's life. A talented person can achieve the prescribed goal easily. In sports, this is important and many a times a differentiating factor between the winning and the loosing teams. However, talent can only be leveraged provided it is available. Thus, talent detection/identification is an important area. In general, talent related issues may be studies under four distinct stages viz. talent detection, talent identification, talent selection and talent enhancement. Talent detection is a preliminary stage and usually performed by experts with their intuitive instincts. Talent identification is more scientific approach to the problem of identifying the superior abilities of an athlete. It is a complex, multidimensional (depending on various characteristics) and multi-staged process[7-11]. Talent selection deals with short-listing from amongst a pool of talented players so as to make a team. Talent enhancement is a continuous process of improvement of skills.

Cricket is a highly popular game in the world. In India alone 55,000 cricket matches are played every day[12,13]. India being a densely populated country, the lack adequate number of quality coaches makes it very difficult to detect talent in early stages. This is especially important as 70% of the Indian population resides in villages/remote areas which are predominantly void of any coaching and infrastructural facilities. Thus, despite availability of talent, the chances of tapping it are very small as the talented cricketers have no means to reach out to the cricket authorities except through publicity given by media. Many a times the selection process is also flawed due to biasness of the selectors.

To address these concerns, we envision a web-based system accessible to cricketing enthusiasts from their respective places. The system will enable cricket enthusiasts to provide specific inputs about themselves to the system. These inputs will be results of various tests (physical, cognitive, anthropometric) performed by them. The system will then classify the person into either of the five talent categories viz. Extra Ordinary Talented (EOT), Very Much Talented (VMT), Much Talented (MT), Moderately Talented (MDT) and Not Talented (NT). The system will also help the athlete in identifying the weaker areas within them which need improvement. The cricket authorities may get alerts, as soon as someone exceeds the threshold of their expectations. The system will also help in selecting the players without any kind of bias.

To recognize the cricketing talent we have identified three most significant characteristics of individuals' viz. Physical/motor abilities, cognitive/psychological abilities and anthropometric abilities[12,14]. These characteristics manifest themselves through 28-paramteres viz. Speed, Agility, Endurance, Stress, Self Motivation Upper Body Strength, Lower Body Power, Reaction, Flexibility, Fatigue Index, Bowler Accuracy, Throw Catching Accuracy, Under Arm Throw Accuracy, Catching Ability, Ground Fielding, VO2 Max, Body Mass Index, Hand Eye Coordination, Creativity, Decision Making Ability, Self Control and Self Monitoring, Willpower, Self Confidence, Integrity and Work Ethic, Shoulder Flexibility, Balance Dynamic, Balance Static and Concentration and Focus[11,14]. Corresponding to each of the 28–parameters, we have also identified simple tests to quantify each one of them[11,13,14]. We also designed a "Cricket Talent Knowledgebase" by collecting the experts' opinions on classifying an enthusiast into the five categories of the talent based on the outputs of the tests.

In this paper, we present various algorithms used by us and show implementation of the Cricket Talent Identification, Enhancement and Selection (C-TIES) system. In section 2.1, we give an overview of the OWA operator which has been used for aggregation of experts' opinion. Section 2.2 discusses Relative Fuzzy Linguistic Quantifier. This is followed by a concise discussion on Normalized Adequacy Coefficient (NAC) in section 2.3. Section 3.0 summarizes the methodology adopted and also includes algorithms. The architecture of the C-TIES system and its implementation has been explained in Section 4.

2. Preliminary

2.1. Ordered Weighted Averaging Aggregation (OWA) Operator

The OWA operator was introduced in[1] to provide means of aggregation, which unifies in one operator the conjunctive and disjunctive behaviour. It provides a parameterized family of aggregation operators including many of the well-known operators like maximum, minimum, k-order statistics, median and arithmetic mean. For n-different scores $x_1, x_2, \ldots, x_n$, the aggregation of these scores may be done using the OWA operator as follows.

$$OWA(x_1, x_2, \ldots\ldots, x_n) = \sum_{i=1}^{n} w_i y_i \ldots\ldots\ldots\ldots (1)$$

where y_i is the i[th] largest score from amongst $x_1, x_2 \ldots, x_n$. The weights are all non-negative and $\sum_{i=1}^{n} w_i = 1$. We note that the arithmetic mean function may be obtained using the OWA operator, if $\forall i, w_i = \frac{1}{n}$ similarly, the OWA operator would yield the maximum function with $w_1 = 1$ and $w_i = 0$ for all i≠ 1. The minimum function may be obtained from the OWA operator when $w_n = 1$ and $w_i = 0$ for all i ≠ n.

In fact, it has been shown[1] that the aggregation done by the OWA operator is always between the maximum and minimum. To find the values of the weights w_i , we need to make use of the relative fuzzy linguistic quantifiers, explained in section 2.2

2.2. Relative Fuzzy Linguistic Quantifier

A relative quantifier, Q: [0, 1] → [0, 1], satisfies:
Q(0) = 0, $\exists r \in [0,1]$ such that Q(r) = 1.
In addition, it is non-decreasing if it has the following property:
$\forall a, b \in [0, 1]$, if a>b, then Q(a) ≥ Q(b).
The membership function of a relative quantifier can be represented as shown in equation (1):

$$Q(r) = \begin{cases} 0 & if \quad r < a \\ \frac{r-a}{b-a} & if \quad a \le r \le b \\ 1 & if \quad r > b \end{cases}, \ldots\ldots\ldots\ldots\ldots (2).$$

where $a, b, r \in [0,1]$ and $Q(r) = Q(i/n)$
In[1], the author has shown computation of the weights w_i of the OWA aggregation from the function Q describing the quantifier. In the case of relative quantifier, with n-criteria[2];
$w_i = Q(i/n) - Q((i-1)/n)), i = 1,2,\ldots,n$, with Q(0) = 0.

2.3. Normalized Adequacy Coefficient

The adequacy coefficient[3] is an index used for calculating the differences between two elements, or two sets, or two fuzzy sets, etc. The adequacy coefficient is very similar to the hamming distance but with some differences. It makes it more complete in a lot of decision-making problems, especially, when we cannot accept that one set (Y) is higher than the other (X). The similarity between two sets in the adequacy coefficient is calculated with $(1 \wedge (1 - x + y))$ or the complement $(0 \vee (x - y))$. For two sets $X = \{x_1, \ldots, x_n\}$ and $Y = \{y_1, \ldots, y_n\}$, the weighted adequacy coefficient can be defined as follows:
Definition: According to Merigo[3], a weighted adequacy coefficient of dimension-n is a mapping WAC: $[0,1]^n \times [0,1]^n \to [0,1]$ that has an associated weighting vector W of dimension 'n' with $\sum_{i=1}^{n} w_j = 1$ and $w_j \in [0,1]$, "s. t."

$$WAC(< x_1, y_1 >, \ldots\ldots, < x_n, y_n >) = \sum_{i=1}^{n} w_i [1 \wedge (1 - x_i + y_i)] \quad (3)$$

where x_i and y_i are the i[th] arguments of the sets X and Y, respectively.
Note that if $w_i = 1/n, \forall$i, then, weighted adequacy coefficient become the normalized adequacy coefficient (NAC).

$$NAC(< x_1, y_1 >, \ldots\ldots, < x_n, y_n >) = \frac{1}{n} \sum_{i=1}^{n} [1 \wedge (1 - x_i + y_i)]$$

3. Talent Recognition in Cricket

3.1. Cricket Talent Knowledgebase

To develop a web based system for talent identification, enhancement and selection system we designed a knowledge database from the opinions of various cricket experts. To gather the opinions, a questionnaire was designed. This questionnaire sought experts' responses on 28- characteristic/parameters identified in section 1. through multiple choice questions. Two additional questions were added to the questionnaire to enable experts identify other parameter(s) which in their view are important determinant to the cricketing talent and not included in our questionnaire. This was also an attempt to ensure completeness of the identified parameters. Each question gave provisions to the expert to classify the talent level of a person having specific output ranges into five talent classes viz. Extraordinary Talented (EOT), Very Much Talented (VMT), Much Talented (MT), Moderately Talented (MDT) and Not Talented (NT)[14]. The experts opinions were collected using a web-based survey and through meeting with coaches at various cricket academies. A sample question from questionnaire is shown in Table1.
Question: Please classify the cricketing talent level of an enthusiast into five categories based on his performance his/her performance in the speed-test.
Speed test method: Enthusiast runs 35 meters in a straight line and record the time in seconds.

Table1: A sample question for speed from the questionnaire.

Talent Class	[<4.8 sec]	[4.8- 5.09 sec]	[5.1-5.29sec]	[5.3-5.6 sec]	[>5.6 sec]
Extraordinary Talented	●	○	○	○	○
Very Much Talented	○	●	○	○	○
Much Talented	○	○	●	○	○
Moderately Talented	○	○	○	●	○
Not Talented	○	○	○	○	●

For each of the talent class (i), the collected expert's assessments were arranged in a matrix EA(i) where columns show the parametric tests and rows show the experts' opinions. The matrix is given in the equation-4. Table- 2 shows possible values for talent classes.

$$EA(i) = \begin{array}{c} \\ e_1 \\ e_2 \\ \vdots \\ e_n \end{array} \begin{array}{c} \begin{array}{cccc} t_1 & t_2 & \cdots & t_{28} \end{array} \\ \begin{bmatrix} v_{e_1t_1}[i] & v_{e_1t_2}[i] & \cdots & v_{e_1t_{28}}[i] \\ v_{e_2t_1}[i] & v_{e_2t_2}[i] & \cdots & v_{e_2t_{28}}[i] \\ \vdots & \vdots & \cdots & \vdots \\ v_{e_nt_1}[i] & v_{e_nt_2}[i] & \cdots & v_{e_nt_{28}}[i] \end{bmatrix} \end{array} \quad \ldots \quad \ldots(4).$$

Table: 2. Talent Classes

i	Talent Class
0	EOT
1	VMT
2	MT
3	MDT
4	NT

The algorithms for talent identification, enhancement and selection are given below:

A. Algorithm for Building Cricket Talent Knowledgebase and Talent Identification

-- Build Cricket Talent Knowledgebase[14]
Step 1: For each of the five talent classes, record experts' opinion in EA(i) matrix as shown above.
Step 2: Normalize the recorded values to (0,1) interval using min-max.
Step 3: For each EA(i) matrix, compute weights for each recorded normalized opinion with the help of Relative Fuzzy Linguistic Quantifier (RFLQ) (equation-2 given in section 2.2).
Step 4: Apply OWA aggregation operator (equation-1 given in section 2.1) to aggregate the opinions recorded in EA(i). This results in the knowledge base contained in five single row matrices containing aggregated opinions for each of the five talent classes.

-- Identify enthusiast's talent level[14]

Step 5: Record the normalized output of the tests for the cricket enthusiast whose talent is to be assessed in a matrix.

Step 6: Compute adequacy values (equation-3 given in section 2.3) between the recorded normalized outcome of the enthusiast and each of the aggregated talent class created in step 4.

Step 7: The talent of an enthusiast is assessed as the class against which the maximum adequacy value is obtained.

3.2. Talent Enhancement

Talent enhancement leads to improvement of performance of players. In order to enhance the talent level, it is important that correct weaknesses are identified at the earliest and the athlete is asked to work on the shortcomings. Given below is an algorithm to uncover the weaknesses of a cricketer. The algorithm produces a list of parameters which need improvement.

B. Algorithm for Cricket Talent Enhancement

Step 1: Record the normalized output of the tests for the cricket enthusiast whose talent is to be assessed in a matrix.

Step 2: Identify the resultant talent class (RTC) of a player using the algorithm given in A.

Step 3: For each of the test t_i, compare the value of the cricketer's test output with the aggregated opinion of expert for that test in the RTC.

Step 4: Identify each test t_i, wherever the cricketer's test outcome is weaker than the result of the RTC.

Step 5: List parameters corresponding to each test t_i.

3.3. Talent Selection

The next issue is to select talented cricketers without prejudice and biasness from a large group of talented persons. The algorithm for talent selection is given below:

C. Algorithm for Talent Selection for Cricket[13]:

Step 1: For each of the player available for selection record the normalized outcome of the tests in a matrix - Players.

Step 2: For each player record in the Players matrix, compute weights with the help of Relative Fuzzy Linguistic Quantifier (RFLQ) (equation 2 given in section 2.2).

Step 3: Compute the aggregated outcome for each player with the help of OWA operator.

Step 4: Sort the aggregated value obtained in step 3.

Step 5: Select the required number of players from the sorted list.

4. Implementation of Cricket Talent Identification, Enhancement and Selection System: C-TIES

Fig. 1 shown below gives an overview of the C-TIES (Cricket-TIS, Cricket-TES & Cricket-TSS) System.

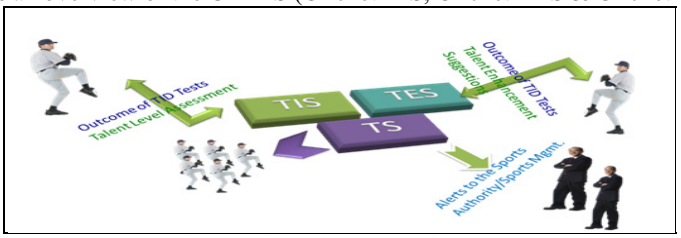

Fig.1: Envisioned C-TIES Architecture

The Talent Identification Subsystem (TIS) module is a major component of the entire system. It provides facilities for creating and managing the cricket talent knowledgebase. It implements various interfaces required to record the

experts' opinions as well as the outcome of tests for the cricket enthusiast. The module also computes the talent level of a cricketer. The Talent Enhancement Subsystem (TES) is responsible for identifying the weak areas where the cricketer needs improvement. To achieve this, module produces a list of tests for which the cricketer is performing below his/her talent class abilities. The Talent Selection Subsystem (TS) has facilities to process records of a number of players and produce n-players from amongst them having relatively better talent levels than the rest of the players in the group.

To implement the C-TIES system we have developed a prototype (core-system requiring enhancements of user Interface and few more features) based on agile methodology and using Open Source Technologies viz. Struts 2.0, Hibernate, J2EE, Ajax, MySql. The Open Source platform has been chosen to provide freedom in future to implementing agencies to continue development of the core system developed by us without technical constraints of the platform. The screen shots of the C-TIES system are attached in Fig 2. Class and activity diagrams for the C-TIES system are given below Fig. 3 and Fig. 4 respectively.

Figure 2: Screen Shots of C-TIES System

Fig.2.A: System starting window

Fig. 2.B: Weight Generating Process

Fig. 2.C: Entry Screen for Enthusiast's outcomes

Fig. 2.D: Resultant Talent Class

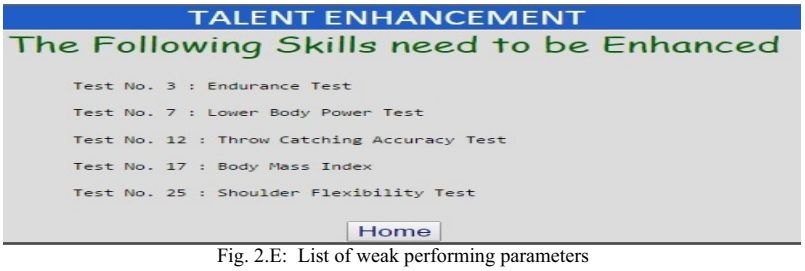

Fig. 2.E: List of weak performing parameters

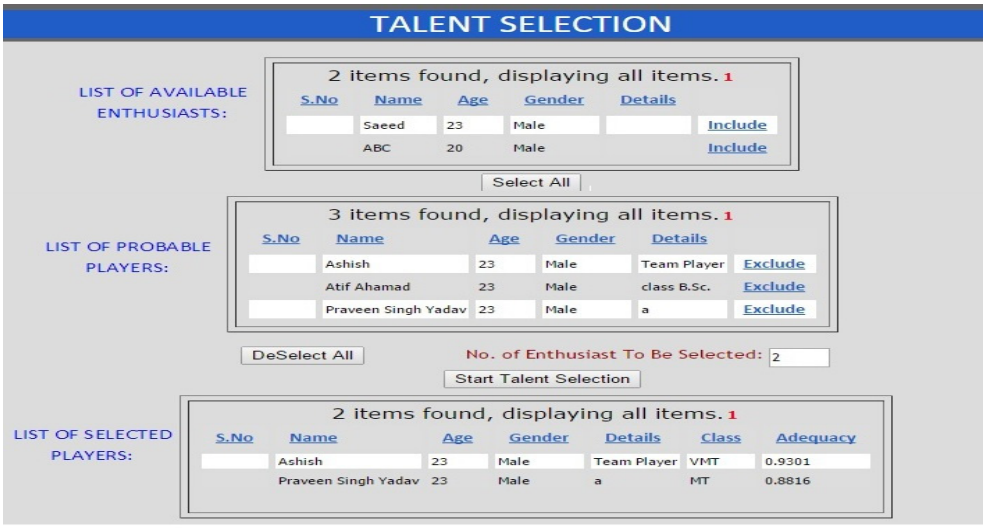

Fig. 2.F: Selection of the included players

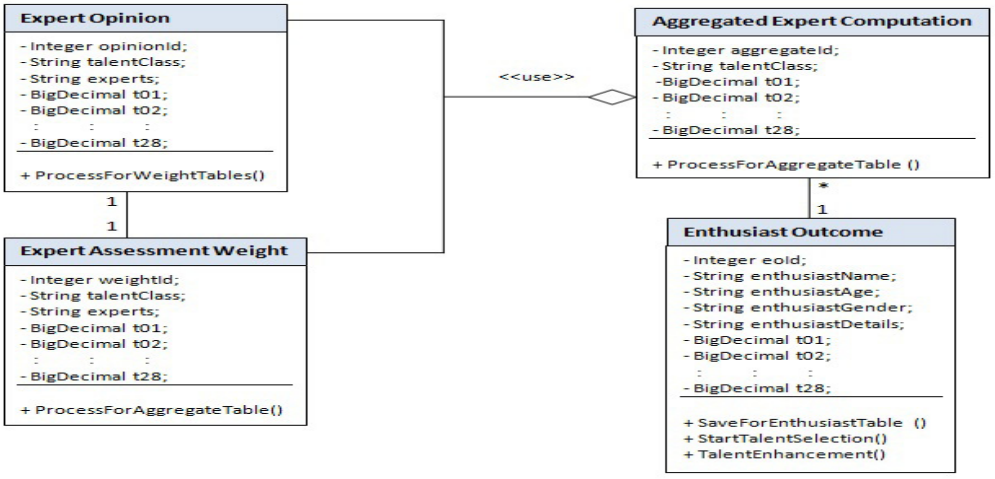

Fig. 2.G: Class Diagram for C-TIES System

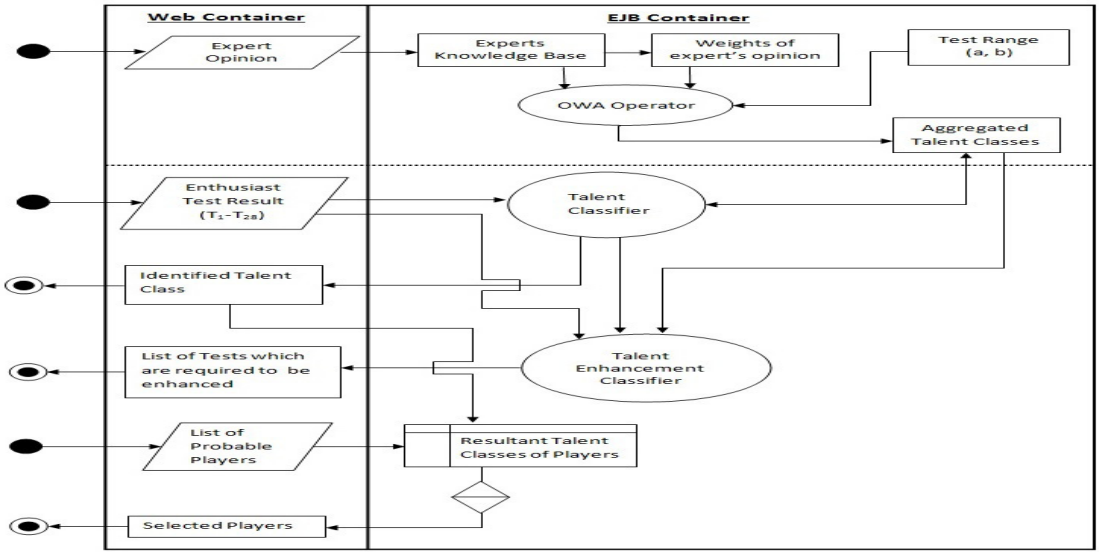

Fig. 3: Activity Diagram for C-TIES System

5. Conclusion and Future Scope

Timely Talent identification, its enhancement and selection are significant issues for cricket authorities and large number of enthusiastic players. Presently no support system is available to address these issues in cricket. In this paper, we have presented "Cricket-Talent Identification, Enhancement and Selection" - C-TIES system which can address this gap. The proposed system addresses major concerns of non-availability of quality coaches, their limited domain knowledge, prejudice and biasness in selection processes etc. In addition, it has potential to alert cricket administrators about Extra Ordinarily Talented player(s) availability in a specific geographical region. A prototype implementation of the core system has been carried out using open source tools and technologies.

The results and screens of C-TIES system are depicted in Fig 2. Figure 2.D and 2.E show the identified "Talent Class and Weak Performing Parameters" of a player with the "Adequacy Value" respectively. The larger the adequacy value the better it is. Figure 2.F shows the result of Talent Selection. The results of C-TIES were validated by performing 2-sided statistical t-test. To apply the t-test we used the output produced by the C-TIES system and the talent levels of the players identified independently by the team's coach The application of the t-test shows that C-TIES has an accuracy of 86.67%.

Availability of more quality cricketing experts may contribute significantly towards improving the knowledgebase of the C-TIES system and can push the accuracy level further. Also, the selection algorithm implemented is only limited to the overall cricketing talent and does not cater to the cricket specialties such as batting, bowling, fielding or wicket-keeping. To address this, the knowledgebase is to be further fine-tuned as per the requirements of various specialties. The system may be further improved by adding a module for Cricket Authorities and alerting features.

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